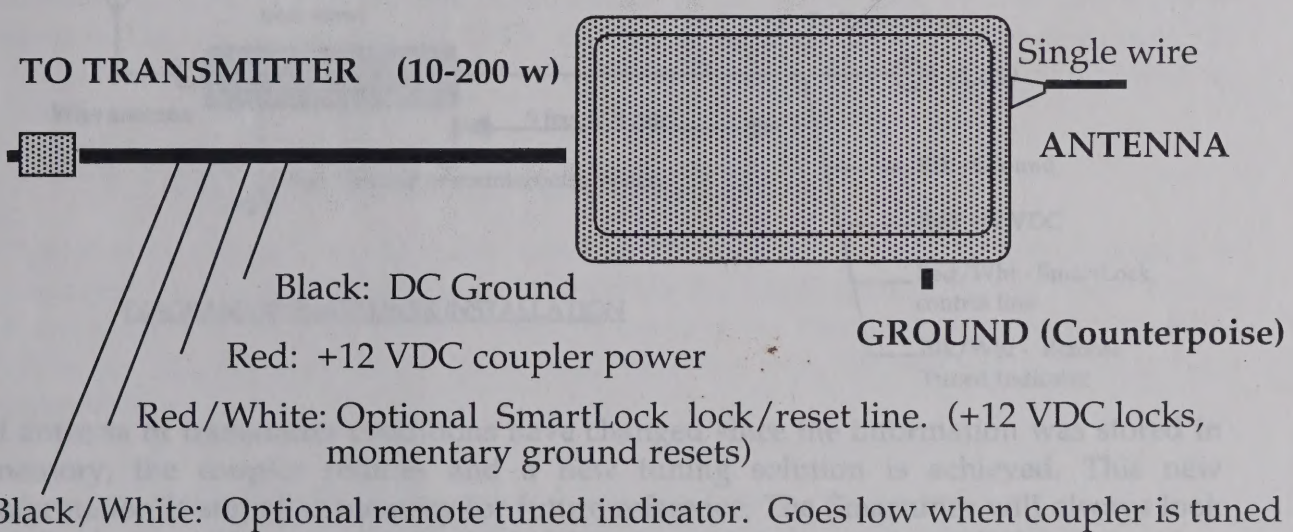
Quick Start Guide

To quickly install your antenna coupler you will need the following:

1. An HF radio with 10 to 150 watts output.
2. An HF antenna with a single wire feed (not coax fed).
   Minimum length of 8 feet (to 3.5 MHz) or 23 feet (1.8 MHz).
3. A good ground or counterpoise for the antenna and coupler
4. +12 VDC and ground for the coupler.
5. An LED or other indicating device. (Optional)

Connections:

Connect the Smartuner as shown in the following diagram:


TO TRANSMITTER (10-200 w)
Single wire
ANTENNA
Black: DC Ground
GROUND (Counterpoise)
Red: +12 VDC coupler power
Red/White: Optional SmartLock lock/reset line. (+12 VDC locks, momentary ground resets)
Black/White: Optional remote tuned indicator. Goes low when coupler is tuned

Operation:

1. Turn on Radio. Apply 12 VDC power to the coupler.
2. As power is applied, coupler should make one "click" sound.
3. Coupler should come up in the bypass (untuned) state.
4. To tune, speak normally, whistle or use CW.
5. Tuning should be done at full power. Clicking is heard.
6. When tuned, clicking stops and Black/White wire goes low.

SGC Inc. SGC Building, 13737 S.E. 26th St. Bellevue, WA. 98005 USA
P.O. Box 3526, 98009 Fax: 425-746-6384 Tel: 425-746-6310
E-Mail: sgc@sgcworld.com Web Site: www.sgcworld.com

1.3 Overall Description

The SMARTUNER is a general-purpose coupler that can operate with any type of radio and almost any type of antenna configuration. The coupler network con-figuration is of a **pi** or **L** type; sensors continually monitor the state of the tuning and relay this information to the processor.

The initial (first time) tuning may take several milliseconds to a few seconds depending on the complexity of the tuning process for a specific antenna configuration. After tuning the first time for a specific frequency and antenna, this information is entered in the non-volatile computer memory that will store up to 170 tuning solutions.

When the same conditions are encountered again, re-tuning is accomplished within 20 milliseconds by recalling the information from the non-volatile memory. Special software has been designed by SGC to allow accurate and fine-tuning of the coupler. For software description, refer to the MicroTune™ section of the manual.

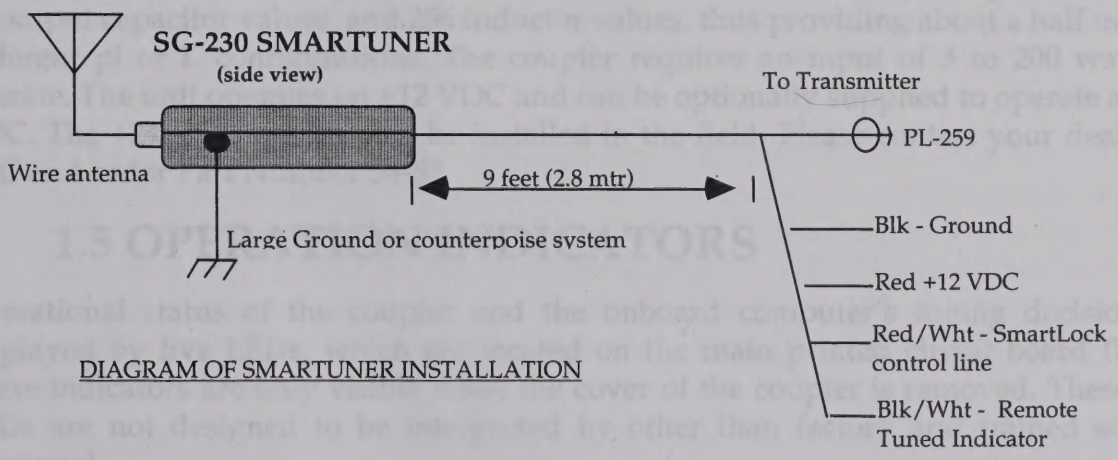


DIAGRAM OF SMARTUNER INSTALLATION

If antenna or transmitter conditions have changed since the information was stored in memory, the coupler retunes and a new tuning solution is achieved. This new information is stored to memory for future reference. The Smartuner will always look for the *best possible tuning solution* and will improve existing tuning solutions whenever possible.

The SMARTUNER may be bypassed and your antenna used as a broadband receiving antenna. To do this, turn off the power to the coupler for two seconds and then turn it back on, or simply press the reset button on the SmartLock. In this situation, the coupler is reset to stand-by waiting for the first RF power to be transmitted before providing a tuning solution. In the stand-by mode, the antenna bypasses tuning elements and connects the antenna directly to the receiver with no tuning elements engaged. This allows for receiving signals throughout the HF range.

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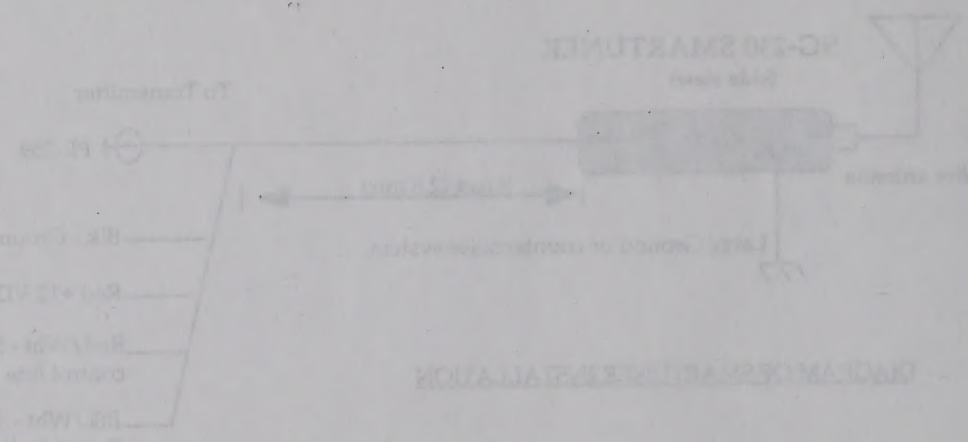

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The coupler will cease to operate normally if input voltage drops below 10.5v DC. This situation may occur if a marginal battery is used or if you are transmitting at high power with an inadequate power supply or battery. Batteries must be fully charged for proper operation. Large gauge wiring to the transmitter and coupler must be used to avoid retuning.

If broadband operation is required during scanning operations, jumper JP-1 on the printed circuit board inside the coupler may be set to the "YES" mode. This will bypass tuning elements on receive. Jumper JP-1 is located near U1.

In some cases, it may be desirable to re-tune the coupler and bypass the memory information. If you wish to bypass the recalled tuning solutions, place jumper JP-2, also located near U1, to the "NO" position.

1.4 Coupler Network Configuration

The coupler network configuration is designed with 64 different input capacitor values, 32 output capacitor values, and 256 inductor values, thus providing about a half million different pi or L configurations. The coupler requires an input of 3 to 200 watts to operate. The unit operates on +12 VDC and can be optionally supplied to operate at +24 VDC. The +24 VDC option may be installed in the field. Please contact your dealer or SGC and order Part Number 54-52.

1.5 OPERATION INDICATORS

Operational status of the coupler and the onboard computer's tuning decisions is displayed by five LEDs, which are located on the main printed circuit board (PCB). These indicators are only visible when the cover of the coupler is removed. These five LEDs are not designed to be interpreted by other than factory and trained service personnel.

CAUTION: Dangerous high voltages exist inside the Smartuner when it is operated with an HF transmitter. High RF voltages in excess of 10kv may be expected in normal operation of this unit. In addition to shock hazard, these RF voltages may produce burns that are very painful if you come in contact with exposed components. Therefore, DO NOT operate without the cover secured in place unless you are a well experienced radio technician or engineer.

As a matter of good installation and engineering practice, exposed metal antenna elements should be located in such a manner as to prevent accidental contact with people (especially young children), pets, and small animals.

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1.6.4 Warranty Note

It is important to have protection from the elements as common weather conditions can reach beyond the capabilities of the coupler. Although the SG-230 coupler is fully waterproof and was created to withstand normal weather conditions, warranty will be voided if left exposed directly to extreme weather such as snow, rain, and ice or prolonged sun exposure. Even in milder climates, direct and constant sunlight can exceed the safe operating temperature and can shorten the lifespan of your coupler.

1.7 Remote Installations

The SMARTUNER is supplied with 9 feet of cable standard. SGC has two standard lengths of antenna extension cable available in the event you need to mount the cable farther than 9 feet from the transmitter. A 25-foot extension cable is available (SGC Part Number 54-65) as is a 50-foot cable (SGC Part Number 54-66).

If you need to install the antenna coupler more than 50 feet from the transmitter site, up to two extension cables may be used for a total of 75 or 100 feet. However, SGC does not recommend installing the Smartuner more than 100 feet from the transmitter because two losses must be considered.

- The first loss in long distance installations is normal attenuation of the radio signal coming from the antenna to the radio via the coax. As you may be aware, the longer the coaxial cable run, the higher the loss will be. The amount of loss is dependent on frequency. At 2 MHz, the loss is approximately .5 dB, while at 30 MHz the loss in 100 feet of coaxial cable is over 2 dB. This means that a 100-watt transmitter would actually deliver about 70 watts to the antenna after running through 100 feet of coax at 30 MHz.

  If you are seeking the utmost performance at 30 MHz and you cannot avoid a run of 100 feet, or longer, we recommend using a larger low loss type of coax such as RG-8 (foam dielectric) or Belden type 9943 coax. Both of these will reduce attenuation to less than 1 dB per hundred feet. You should be aware that this heavier cable is less easy to work and may be quite expensive.

- The second loss which must be considered is the losses in the DC power and reset control line. At any distance other than the 9-foot cable that is supplied by SGC, we recommend that the DC voltage at the antenna coupler be measured because if the coupler voltage drops below 10 volts, the coupler may not operate properly.

  For this reason, SGC recommends that if distances are great, the input DC voltage at the transmitter site be adjusted to provide for +12 to +14 volts at the coupler site.

We do specifically advise against use of a different power supply than the one used to power the radio because of the danger of creating ground loops which may cause oscillation of the final amplifiers or other undesired side effects. If you decide to use a

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separate power supply mounted at the antenna coupler location, please be advised that SGC does not provide technical support in this area.

1.8 Upgrade Sequence

The current version of the SMARTUNER coupler will have a revision letter located on the printed circuit board. To continue moving forward in coupler design, the SMARTUNER may be revised as needed. Later revisions of the coupler will be denoted by the subsequent letters of the alphabet.

SGC will continue making incremental improvements in the SMARTUNER product. When you buy your product today and a new feature is added, you can always upgrade for modest fees to the latest version of the unit. If you would like to upgrade to the latest version of the unit, contact SGC because special discounts are always provided to our valued customers.

2.0 SPECIFICATIONS - SMARTUNER

HF Frequency Range:	1.8 to 30.0 MHz **Note:** The SMARTUNER may be operated as low as 1.6 MHz and is commonly used as an antenna-matching unit for differential GPS transmitter site antennas. However, when operated under these conditions, a longer antenna is recommended, such as a 60-foot tower section for operation in the 1700-1710 kHz band and an appropriately larger counterpoise. In addition, inductor heating may become pronounced at high power levels in the SMARTUNER's inductors, which are commonly used at these frequencies. For this reason, we recommend 70 watts at 1700 kHz and 50 watts at 1600 kHz on a continuous basis.
Power Input Range:	3 to 200 watts (PEP)
Input Impedance Range:	45 to 55 ohms
VSWR: (Typical)	Typically less than 1.4:1
DC Input Requirement:	+13.8 VDC
DC Operating Range	+10.5 to 15 VDC
Input Current: Average:	.9 amps
Random set time:	Typical: less than 2 seconds
Recurrent set time:	Typical: less than 10 milliseconds
Non volatile memory address:	170
Antenna Length:	Minimum length of 8 ft. —3.5 to 30 MHz Minimum length of 23 ft. —1.8 to 30 MHz
Installation:	Any position

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2.0 SPECIFICATIONS - SMARTUNER

Operating Temperature:	-35° to +70°C
Size:	16 x 12 x 3 inches
Weight:	8 pounds (3.5 kilos)
Case Construction:	Plastic ABS weatherproof case
Control Cable:	SGC special cable, 9 feet coaxial and two power Input wires (plus remote tune LED wire replaceable by any standard cable)

2.1 Accessories

Shock Mounting Tray. SGC Part Number 54-50

+24 VDC Power option. SGC Part Number 54-52

25-foot extension cable. SGC Part Number 54-61

50-foot extension cable. SGC Part number 55-62

2.2 Recommended Antennas

SG-105 Marine and Base station antenna. This is a 60 foot end fed long wire type antenna. SGC Part Number 55-10.

SG-107 Delta Loop Antenna. This is a delta loop 11 meters high by 11 meters wide at the base. SGC Part Number 55-12.

SG-203 Marine 28 foot whip antenna. This antenna is used for most powerboat installations. SGC Part Number 55-24.

SG-303 High performance 9-foot whip antenna. This dual element antenna is designed for severe marine and land mobile service. SGC Part Number 55-27.

QMS - Quick Mounting System that houses SMARTUNER Smartuner and also provides a sturdy mounting platform for the SG-303 antenna system. Designed for fly away installations requiring no holes installation of high performance HF antenna system. SGC Part Number 55-45.

3.0 Parts and Technical Support

SGC supplies SMARTUNER equipment; the user supplies suitable radio and antenna.

3.1 Parts Furnished

1. Antenna Coupler
2. 9 foot special cable (RG-58 plus 4 conductors in a single jacket.)

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3. Instruction Manual

3.2 User Supplied Items

The user of the SMARTUNER will need to supply a suitable HF radio antenna. Such an antenna may be as simple as an 8-foot-long piece of wire and several ground/ counterpoise radials of 8 feet or longer. The longer the antenna, up to about 80 feet, the better all around performance will be. Longer antennas may be used, but please refer to the sections on antennas for discussion of limitations.

The user will also have to supply a good counterpoise. Such a counterpoise is a large metal surface (much larger electrically than the antenna). Generally, the bigger the counterpoise, the better your signal will be.

3.3 Technical Support

Before contacting SGC for technical support, please take a few minutes to think through your installation and ask if there is anything obvious that you have overlooked in the installation. Check to make sure your ground system is both adequate and tight and that proper voltage is supplied to the coupler.

In the event you experience difficulty with your SMARTUNER antenna coupler, you should contact SGC for technical advise. Before calling, we ask you to have the following information ready so that we may readily assist you.

Coupler Information. Please have the serial number of your coupler, the name of the dealer from whom the unit was purchased, and the approximate date of purchase.

Antenna Information. Please be ready to describe your antenna installation. You will need to advise us whether the antenna is a wire type, a dipole, V, vertical, long wire, or whip antenna.

Ground System. You should be ready to describe your ground system in detail. If you are dealing with a marine installation, you should have a description of the vessel's bonding system. If you are using the coupler in a mobile setting, you should be able to describe bonding of the hood, trunk, and other vehicle parts that may have been done. In an aircraft, you should be able to describe location of the coupler and type of ground connection used.

Power supply voltage. One of the common mistakes made when installing couplers is to assume that a connection is good when it hasn't been measured. If you experience any type of erratic or intermittent operation, please measure the power supply voltage *inside the coupler*.

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This antenna is recommended only for vehicular mobile installations. The short length will result in poorer performance compared with the longer antennas. A special high performance 9-foot antenna, the SG-303, is manufactured by SGC specifically for this problem. (SGC Part Number 55-27.)

7.0 to 8.5 Meters (28 feet)

This antenna is recommended for marine installation on smaller vessels. It may also be used in base stations if there is no way of using a longer antenna. The SG-203 is this type of antenna. (SGC Part Number 55-23.)

10.7 Meters (35 feet)

This is the preferred antenna for marine installation when there is no room for a longwire antenna. It will also provide reasonable efficiency for base station use and is the shortest recommended base antenna. (SGC Part Number 55-24 for the SG-204 35 foot whip antenna.)

4.3 Longwire Antenna—23 Meters (75 feet); 46 Meters (150 feet)

For most applications, the longwire antenna will give the best results and is recommended when practical. The diagrams at the end of this section show some recommended methods of installation. These are only a few of the many possible methods of installation, and frequently a different configuration will be the best at a particular site. SGC's long wire antenna, 60 feet in length, provides efficient operation on low frequencies and high frequencies alike. (SGC Part Number 55-10.)

4.4 Backstay Antennas —8 Meters (28 feet) and Longer

Although we would love to sell everyone a high performance marine whip antenna, the backstay of a sailboat is almost impossible to improve upon in most installations.

4.5 Typical Installations

Figures 4.5.1 through 4.5.11 show some typical installations for the automatic antenna coupler.

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5.0 General Notes on Antennas and Couplers

1. The longer the antenna, the generally better the antenna performance. By doubling the length of the antenna, an improvement of 3 to 6 dB can be expected in your radiation or receiving characteristics. This is the equivalent of transmitting with 400 watts, when actually you are using only 100 watts.

2. A ground for end-fed antennas can be effectively created by running radial wires from the coupler point and burying them in the ground. We recommend for a good ground that 12 radials should be used and they be about 1/3 longer than the antenna length. The number of radials can be reduced; however, you need at least one. Efficiency pattern and radiation will decrease in proportion.

3. Antennas will always perform better if the wire is of a large gauge. Never use anything less than gauge 16. If gauge 6 is used, an improvement of 6 dB can be expected over the 16 gauge. The radial ground wire should be at least the same size as of the antenna wire.

4. The SMARTUNER coupler can handle antennas beyond the specified minimum range of 8 to 80 feet and should be extended as much as possible. In some cases, the antenna can be 300 feet or longer. In this situation, you may find some tuning holes. The antenna can be made a little shorter or longer to overcome the tuning hole on the frequency band you may have wanted to use.

5. Always install the antenna system as far away as possible from any electrical or industrial noise source. Electrical appliance, electric motor, or fluorescent lighting noise may cover up weak or even strong signals.

6. A remarkable antenna coupler, the SMARTUNER will tune practically any antenna—good or bad. Keep in mind that it is not the coupler that will radiate the RF energy, it is the antenna. Therefore, use only good size wire and long antennas.

7. Never use a feed line or coaxial cable at the output of the antenna coupler. The coupler functions to couple the radio to the antenna, not to act as a mid point connector. Because the antenna system starts at the output of the coupler, the lead end from the coupler to the hypothetical antenna is part of the antenna system. Avoid having the lead end wire touch any other metal structure: it will capacitively short your antenna to ground.

8. The backstay of your mast is the *only* viable antenna on a sailboat. The SMARTUNER coupler is specifically designed to be used for such applications.

9. For vehicular installation, do not use any inexpensive CB antennas and/or mounts. These antennas will not perform well from 1.8 to 10 MHz even though

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the coupler will load and tune the antenna whip. A high voltage of 15,000 to 30,000 volts RF will be applied to the antenna depending on the RF power level and frequency. The inexpensive ball mounts for CB antennas are not designed for so stringent a purpose. We recommend the use of an antenna system such as the SG-303: it was specifically designed for such extreme applications.

5.1 Steps to Antenna Installation

System installation is a three-part process covering the following steps:

1. Selection and installation of the antenna

2. Mounting the antenna coupler

3. Connecting the appropriate interface cables between the coupler and the transceiver

This manual section will discuss the three steps mentioned above in detail and will provide sufficient information to enable the user to confidently install a complete system properly.

The antenna system is a key part of the communication system. For satisfactory operation the system must be carefully selected and then installed correctly. The unbalanced antennas used with the automatic antenna coupler use the ground (counterpoise) as half of the antenna system. The ground forms an "image" antenna and is a critical part of the system. It is essential to consider both the ground and the antenna when designing the system installation.

5.2 Antenna Location

The figures in Section 4.0 illustrate several different antenna installations. The following points should be carefully considered when designing the antenna system.

a) The antenna should be located in a position free of obstructions, particularly in the desired direction of communication.

b) The antenna should be kept as far away as possible from buildings, trees, and vegetation. If metallic masts or supports are used, arrange the insulators so that the antenna is spaced at least 2 meters from the mast.

c) Remember that the radiating part of the antenna starts at the coupler. The location of the bottom portion of the antenna is important.

d) Vertical antennas have an omni-directional radiation pattern, providing equal performance in all directions.

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e) Horizontal wire antennas have maximum radiation broadside to the antenna when the frequency is less than 1/4 wavelength. As the frequency increases beyond 1/4 wavelength, lobes will appear in the radiation pattern with the principal lobes becoming closer to the plane of the antenna as the length increases. At all times, radiation will be minimal at the end of the antenna; therefore, it should be located so that the ends point in directions where communications are not required.

f) The V antenna construction minimizes the directivity of the horizontal antenna and is recommended for all around coverage. In addition, the V antenna is a compromise between vertical and horizontal polarization and will give good results for communications with land or marine mobiles using vertical whip antennas.

g) High voltages (sometimes exceeding 30,000v RF) are present on the antenna. All parts of the antenna and coupler must be located or protected so that there is no possibility of accidental contact.

h) Do not locate the antenna close to other antenna systems.

i) Make sure that the antenna is rigidly supported. The antenna will de-tune if it sags or sways.

j) The connection from the coupler to the ground must be a small percentage of the total length of the antenna. Do not let the length of the ground strap exceed 1.5 meters. Use heavy gauge wire or strap for ground connection.

k) Whip antennas should be connected with the minimum length of wire. (Do not exceed 0.6 meters).

l) Do not locate the coupler farther from the transceiver than necessary. If the distance exceeds 10 meters (30 feet), we recommend you use low loss coaxial cable, such as RG-8 or Belden type 9943.

5.3 Ground Systems—General

The ground system (also called a counterpoise) is a key part of the overall antenna system and is the primary cause of poor performance and the difficulty of adjusting the coupler. A good ground is essential.

5.3.1 Vehicle Grounds

Connect the coupler directly to the frame of the vehicle. Ensure that a heavy strap is used from the coupler ground lug and that the connections are cleared of all paint and dirt so that the shiny metal is exposed. SGC always recommends that two grounding bolts with star washers be used to ensure no ground resistance is encountered. Make

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If you are using a backstay antenna, try to visualize your ground as you look down from the top of the mast. Ask yourself if you see 100 square feet of metal below you. The closer to this figure you can get, the better your radiated signal will be. What you are trying to do is make a large capacitor to the seawater. Consider the salt water of the sea to be one plate of a capacitor, the ground system the other, and the hull to be the dielectric.

On marine installations, you should also be aware of potential noise sources that may need to be bypassed to ground. We have encountered just about every source of noise imaginable in vessel installations. The best time to track down annoying noise sources is when you are laying in a ground system. Not only will you get much better voice communications, but Weatherfax, Navtex, and Loran reception will improve as well if they are also tied into the ground system.

Particular attention should be paid to any device that uses an electric motor. This means to turn on the water pressure pump, bilge pump, hot water forced air heater fans, refrigeration, and auto pilot motors. A few small capacitors to ground (.01 microfarads at 100 VDC) can resolve many issues. Bypassing of the vessel's alternator is also a good idea.

5.3.3 Base Station Grounds

In areas of high ground conductivity, an effective ground can be made through a grounding rod. The rod should be approximately 3 meters in length and should be installed as close as possible to the coupler. It may be necessary to use several ground rods bonded together to improve the ground contact. Water pipes are sometimes recommended as grounds and may be used provided plastic pipe is not buried as part of the system and the following conditions are met:

a) The water pipe is close to the coupler.
b) The water pipe enters the ground close to the coupler bonding point.
c) There are no joints or couplings in the pipe that will increase the resistance path to ground.
d) The water pipe enters soil with good conductivity.
e) A low resistance contact is made to the water pipe.

Earth requiring a counterpoise. Frequently the ground conductivity will not suffice to provide satisfactory operation of the coupler—almost certainly the case with well drained sandy, rocky, or loamy soils. Therefore, a counterpoise (artificial ground) must be used as the ground system.

Rooftop installation requiring a counterpoise. In a rooftop installation where there is no existing ground plane, the ideal ground would be a conducting surface ex-tending several wavelengths in all directions around the antenna. On a rooftop, this situation may be approximated by placing a screen of chicken mesh, copper hardware cloth, or

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similar material over the roof of the building. More frequently, a counterpoise system of radial wires must be used. SGC recommends the use of at least 8 to 12 radials bonded together in the center. If the antenna is at ground level, the radials should be buried a few inches below the surface.

5.4 Corrosion

Ground connections are subject to corrosion and oxidation. All joints must be clean and the hardware adequately tightened. Joints should be well soldered wherever possible. The joints may be protected by an application of silicon grease and, under severe conditions, covered with electrical tape and waterproof varnish or a durable brand of silicon caulking.

If you are mounting your SMARTUNER on a vessel where a lot of salt spray is encountered, it is a good idea to put the wire connections that are exposed to weather on your six-month periodic maintenance plan. Then, every six months, you will be reminded to undo each of the connections, clean, retighten, and reseal.

Use jumpers around metal backstay triangles on split backstay antennas. Corrosion may cause up to several hundred ohms of resistance to occur even though you may think that a metal-to-metal connection would be a good one.

5.5 Antenna Coupler Mounting

The coupler is mounted using the proper mounting ears on the case. Choose a location immediately adjacent to the antenna feed point. In trunk-mounted mobile installations, locate the coupler so that the antenna insulator is within a few centimeters of the antenna exit hole. Note also that the antenna lead must pass through an insulated bushing. High voltage connecting cable must be used. (RG-8U cable with solid insulation may be used if the outer shielding is removed). When the coupler is installed on the outside, or on the deck, we recommend a protective housing.

5.6 Antenna Connection

The antenna lead is connected to the high voltage insulator. During operation, use two wrenches when tightening the nut to prevent the stud rotating. A potential of several thousand volts may be present at the antenna terminal and adequate protection must be made against accidental contact. It is also necessary that the antenna be spaced at least 3 centimeters from the conducting surface. Sharp points in the lead-in wire should be avoided to prevent corona discharges.

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When installing your SMARTUNER, remember to allow for the power to be disconnected from the battery during periods when equipment is not being used. This will prevent draining the battery unnecessarily.

6.3 Smartlock Installation

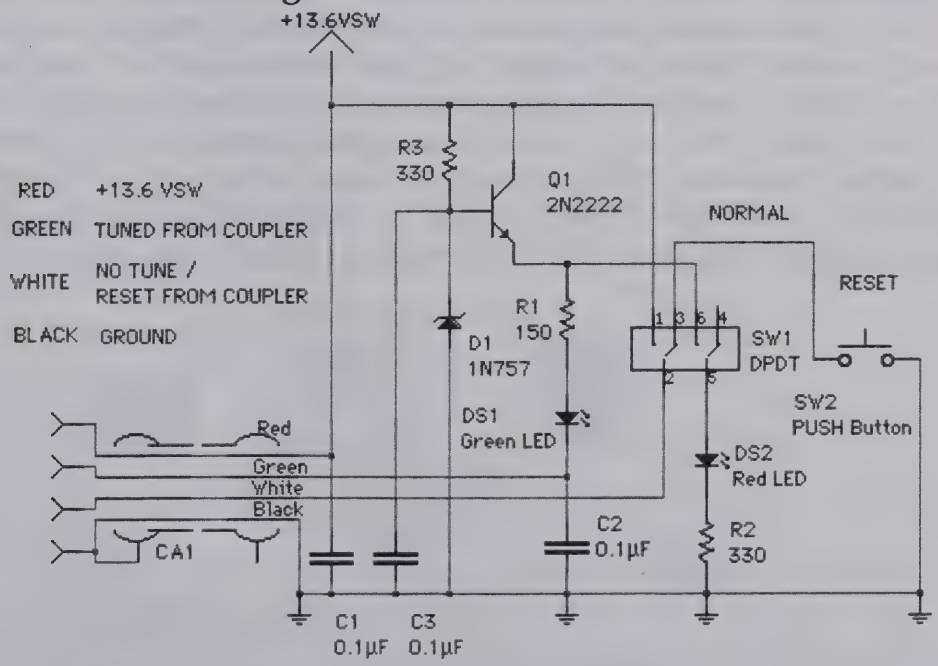
The SmartLock is an optional accessory with the SMARTUNER. This gives the user additional control over the coupler. It is not required for normal operation of the coupler and does not need to be installed. It allows the coupler settings to be held in place so no tuning or retuning will occur, and has an LED indicator which will light when the coupler is tuned, and provides a manual reset of the coupler without turning the power off and on.

Connections:

SG-230	Smartlock
Red wire (+12VDC)	red wire
Black wire (Ground)	black wire
White/Black wire (TND)	green
White/Red (Reset/Lock)	white

We recommend soldering the wires together and insulating the exposed wires with heat shrink or electrical tape; however, other methods may suffice as long as the connections are firm and there is no exposed wiring. A schematic drawing is provided as an aid to understanding the operation of the SmartLock.

Smartlock Schematic Diagram



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6.4 Weatherdeck Mounting

Weatherdeck mounting can be used. Years of experience have shown that inside mounting or even splash-proof mounting is preferred, particularly in cold, damp environments. In tropical use, shielding from direct sunlight is desirable.

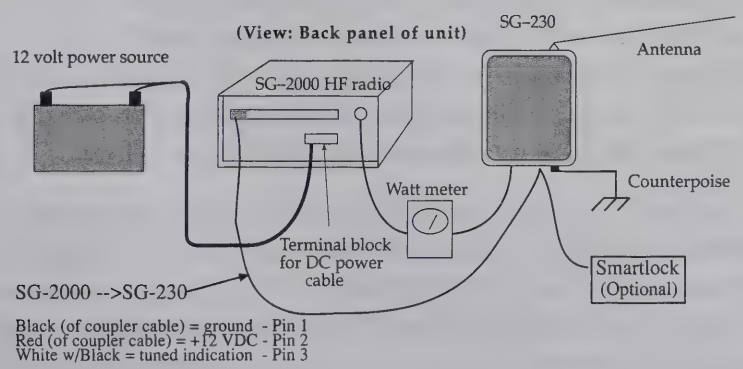
The base of the antenna should be connected to the high voltage feed-through insulator on the housing. Note that this insulator is not designed to support heavy mechanical loads. If such loading is encountered, use a strain insulator.

The ground system should be connected to the 1/4-inch stainless steel stud protruding from the bottom of the housing. Connection to the ground system is extremely important to a successful installation. Ground runs of over a few inches should be made from 4-inch-wide copper strap or larger. The actual ground system should be as good as possible, as the ground is an integral part of the antenna system. See section 5.3 on grounding. However, couplers in general require the antenna parameters to be within the range of the tuning parameters or the coupler will not find a satisfactory match. The computer in the SMARTUNER cannot second-guess the installer.

A proper antenna/ground installation is of great importance: regardless of whether your station is a base station, marine, or land mobile.

6.5 Electrical Checkout

After the SMARTUNER antenna coupler has been installed, the SSB transmitter should be adjusted to the *highest* frequency desired, and a directional watt meter (e.g., Bird Model 43) should be inserted into the transmission line. The transmitter should then be powered. The SMARTUNER will begin to tune when RF power is applied, and you will hear a "clattering" of PC-mounted relays. If the antenna length and ground parameters are within range, the relay noises will stop when just a few words are spoken, and the reflected power on the watt meter would indicate a value of better than 2:1 VSWR. The "TUNED" LED, which is mounted on the PC board, will light, and if there is a remote "TUNED" indicator, it will also light.


(View: Back panel of unit)
SG-230
Antenna
12 volt power source
SG-2000 HF radio
Watt meter
Counterpoise
Terminal block for DC power cable
Smartlock (Optional)
SG-2000 -->SG-230
Black (of coupler cable) = ground - Pin 1
Red (of coupler cable) = +12 VDC - Pin 2
White w/Black = tuned indication - Pin 3

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Next, the SSB transmitter should be adjusted to the *lowest* desired frequency, and the test as outlined above should be repeated. The SMARTUNER should immediately sense the mismatch and switch to the tune mode to retune the antenna system. Since the algorithm must search through more possible values of L and C to find an appropriate combination at the lower frequencies, the tune cycle may take longer. A few spoken words should achieve an "all tuned" indication. The SMARTUNER installation and tune-up are considered complete if the above tests have been successfully performed.

The SMARTUNER will probably not be supplied from SGC with memory data appropriate to your installation, and the memory feature may not seem impressive at first. Allow the SMARTUNER to "learn" your antenna's requirements by proceeding from frequency to frequency and allowing the normal tune-up to occur. As the SMARTUNER computer memorizes more and more frequencies, you should then be able to return to a previously tuned frequency and find that the coupler immediately responds "ALL TUNED," even before the first word is completed.

The memory system is capable of storing hundreds of individual frequency/relay combinations, mostly in the lower operating frequencies, providing better memory resolution at lower frequencies where antenna systems are inherently narrow band. Usually, only one or two memory positions are needed to provide satisfactory coverage at higher frequency bands.

6.6 Do-It-Yourself Light-Bulb Dummy Load

Any time that a transmitter is used, it must be outputting into a load. A load is anything that the output power can be pumped into. If the transmitter is operated without any sort of load connected, the final amplifier stage could become severely damaged. The problem is that you should never test a transmitter on the air for the first time, if you are unsure about how to operate it, and if you are unsure whether it is working properly. You could create harmful interference to other stations.

To test transmitters without actually operating into an antenna, dummy loads were created. A dummy load is a load that will dissipate the energy from the transmitter instead of emanating it into the ionosphere. Nearly all commercial dummy loads are large oil-filled cans. These dummy loads change the transmitted energy into heat, which is absorbed by the oil. Because different transmitters output different amounts of power, different sizes of dummy loads must be used. Dummy loads for typical amateur powers (under 500 watts) are relatively inexpensive and are readily available.

Unfortunately, when you use a can-type dummy load, you can't see "what's happening" with your transmitter. In this case, you can use a light-bulb dummy load to test your transmitter. Here, the light bulb is directly connected to the output of the transmitter and it dissipates the RF energy as light. The light bulb dummy load is more useful than the oil-can type because you can guess how much power is being output, you can see

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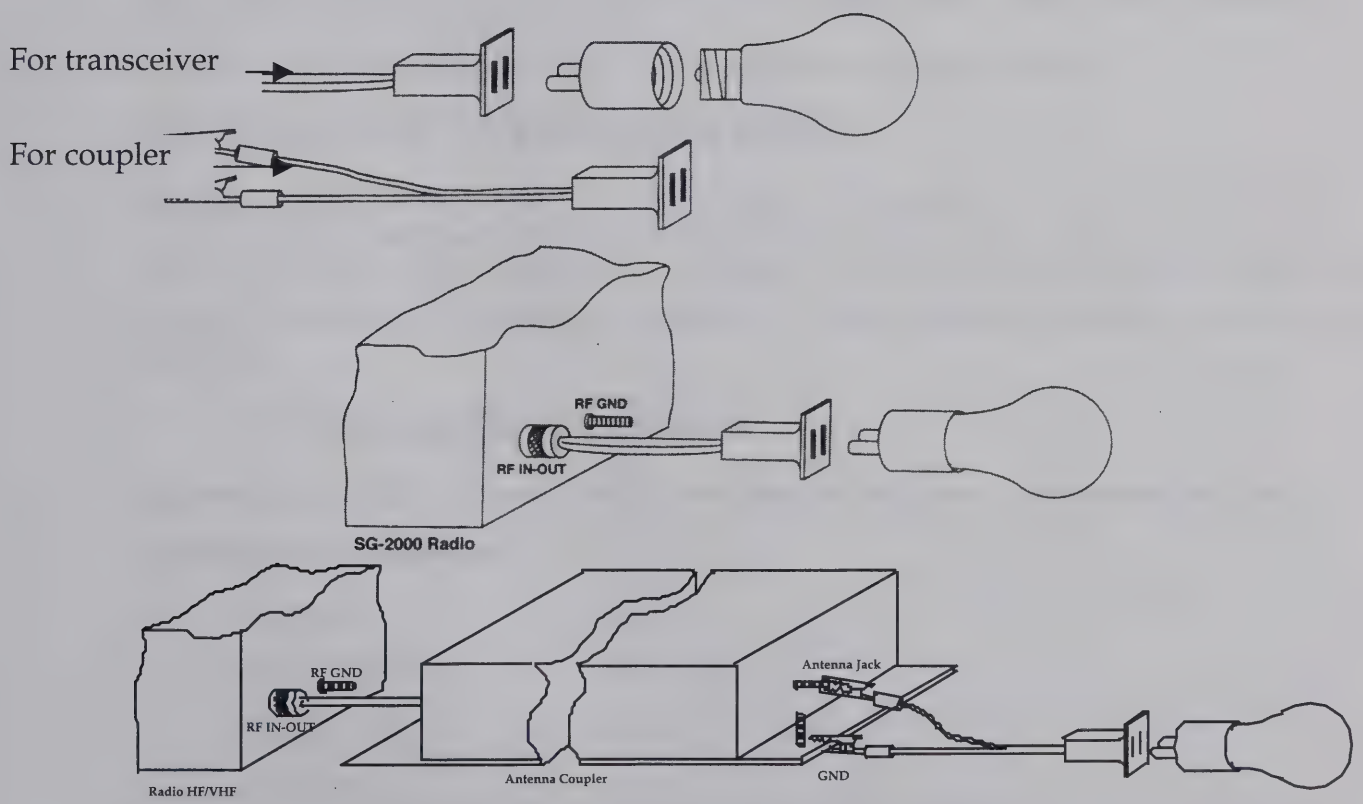
the voice modulate the SSB (the light will flicker with your voice peaks), and you can tune the transmitter for maximum output (if the transmitter is an older model that requires tuning).

Before building or using the light-bulb dummy load, remember that these models typically don't dissipate the transmitter's output as well as an oil-can dummy load. The result is that RF will "leak" out; I have heard a few stories of amateurs who were heard around town while operating their transmitters into a light-bulb dummy load. If you use this system, make sure that you test the equipment on a clear, harmless frequency (NEVER test with the transmitter set on an emergency frequency, such as 2182 KHz).

SGC recommends that you build the light-bulb dummy load with the following parts (although I have made one with an old light fixture and a makeshift version with just alligator clip leads and a light bulb):

* AC socket to cable with a PL-259 connector (for transceiver)
* AC socket to cable with alligator clips (needed with coupler)
* Light bulb to AC adapter
* 75 to 125 watt light bulb, 120 to 220 VAC
* 100 watt radio transceiver
* SG-230 coupler (optional)



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RADIO TEST PROCEDURE

1. Connect the transceiver light bulb load to the radio RF in/out jack.
2. Turn on the radio and set the CW mode.
3. Key the PTT switch on the microphone and look at the light bulb. If the light bulb load is connected and the radio is transmitting, the light should turn on.
4. Set the power to LO.
5. Set the radio to SSB mode.
6. Key the PTT switch on the microphone and talk into the microphone. Notice that the light turns on when you talk.

COUPLER TEST PROCEDURE

1. Connect the coupler to the radio.
2. Connect the coupler light bulb load to the SG-230 antenna jack.
3. Turn on the radio and the SG-230.
4. Set the radio to the CW mode.
5. Key the PTT switch on the microphone and look at the light bulb. The light should turn on if the coupler has completed its' tuning cycle and if the radio is transmitting.
6. For further testing, follow steps 5-6 of the radio test procedure.

Note: The light bulb might not turn on immediately if the coupler has not yet been tuned for the frequency of the transmitter. The output power (light-bulb brightness) is greatest when the coupler is properly tuned.
This test will ensure that the radio and coupler are working properly.

7.0 Coupler Configuration

Schematic Q30102000, sheet 4 is the schematic diagram of the two basic coupler networks. Note that the **L** network as viewed from the generator, may be configured as either "C in" or "C out," whichever is required by the load. In either case, the end of the network containing the shunt C element will be the ***higher*** impedance end of the network.

7.1 Schematic Diagrams

Schematic Q30102000, sheets 1 thru 6, are schematic diagrams of antenna coupler.

Connections to Smartuner

RF Input	ST-1
RF GND Input	ST-1
13.6 (24) VDC	ST-7
DC GND	ST-8

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sure the stainless steel ground stud is well connected to the coupler. In fact, we go so far as to use large braid on the inside of the coupler.

Particularly in automobiles and aircraft, a single ground connection ***will not do***. It is mandatory that at least two ground bolt connections be used.

Inaccurate assumptions. The fifth situation to check for is what we call *"dangerous assumptions"* about the ground system. When you bond from the antenna coupler to copper or iron water pipes, you might make an assumption that the water pipes are a good ground. But in many installations, copper pipes are used in the building but a plastic main connects to the municipal system just outside the service entrance. So much for a good ground.

11.2 Antenna Faults

The key to getting the most out of your SMARTUNER is to realize the antenna begins right at the ceramic feed through insulator on the SMARTUNER case. In other words, this is the feed point of your antenna system. Failing to install your coupler accordingly will result in unsatisfactory operation. With this concept in mind, you can easily avoid some of the common troubles with a properly planned installation.

Coaxial cable on output. Coax on the output is probably the single most commonly asked question about the coupler and is the most misunderstood. Let us reiterate: The SMARTUNER was not designed to feed a piece of coax.

Stray ground capacitance. Stray ground capacitance is the next largest cause of malfunctioning installations. If you have a long lead wire from the coupler to a feed-through (on a wall or bulkhead), you significantly increase your chance of problems. Wire running parallel to a grounded surface may represent a significant capacitance to ground and, just as with coax, this will cause problems.

To give you an idea how these two points can cause problems, let us relate an incident that happened in late 1992. A SMARTUNER user had a coupler installed in a mobile ham radio installation. The coupler could not find a lock on several bands. After going through his installation carefully, the user called SGC for technical support. This user was nearing wit's end.

In working through the logical troubleshooting process with him, we discovered that he had used coaxial feed line from the insulator on the coupler to the antenna feed point. Because he had read about the dangers of capacitance to ground in an earlier edition of this manual, he did not have the coax shield grounded. We had him remove the ungrounded braid and the installation worked fine.

Experiences like this have taught us to be fanatical about using the shortest possible wire and no coax on the output of the coupler.

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Another key lesson here is that even if you have a low capacitance lead, a high capacitance antenna will not work well. If you have a whip type antenna, mounted on the back of a van, you will have a large portion of the antenna running right next to grounded sheet metal. This causes a high loss to ground, one reason why we do not recommend CB type whip antennas. The other reason is the base insulation in ball mounts is inadequate for everything but extremely low power.

Long lead lines. If you have a SMARTUNER feeding a 9-foot antenna with a 1-foot feed line located inside a hull or inside a vehicle, you have 10% of the antenna where it will do you no good. If you have more than 5% of the antenna inside a grounded cabin, you will begin to lose performance.

A good rule of thumb is that under one foot of feed line is a good installation, one to two feet aren't very good installations, and over two feet means you are asking for trouble.

"Odd reactance." The next category of antenna fault is what we call the "odd reactance" problem. Although the SMARTUNER is an exceptionally well-designed product, you may from time to time find an antenna length that just won't quite work right. Generally this occurs when the SMARTUNER is having a tough time making up its mind about which of two tuning solutions is better. If it is a very close call, you can have an antenna which causes cycling and just won't stay locked.

The solution in such cases is to add or subtract a couple of feet of wire from the antenna. This generally cures the problem.

As part of your check-out of an HF system, you should operate on all channels and frequencies which you plan to use on a regular basis to insure the coupler and antenna which you have provided work well.

Antenna insulators. Sporadic operation may be caused by poor antenna insulators. We have seen on sailboats, for example, people trying to save money by expecting the fiberglass hull to act as an insulator and not using a lower insulator. The hull is not a good insulator and a thin layer of wet salt water will degrade the ground further. Similarly, mobile HF users who rely on a poor quality ball-mount find these are especially prone to arc over inside the ball mount where it is difficult to detect.

The point we are making here is simply this: you should have a leakage path of 2 inches at all points on your antenna and especially in the area of the feed point: 10,000 to 30,000 volts of RF energy will not be adequately confined by inexpensive insulators.

11.3 Transmitter Faults

Some vexing problems don't relate directly to the antenna or the ground system but may nonetheless cause difficulties. Here are two of the most common types:

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Oscillation. The transmitter may have a tendency to oscillate. The general symptom is that the coupler will work well with another radio but will not tune correctly when the desired radio is in place. The coupler finds a tuning solution, as indicated by the remote tune indicator going on, but then resumes hunting. In a majority of cases this will be caused by an overly sensitive transmitter final amplifier section or by inadequate shielding around the amplifier.

We know of several radios that oscillate relatively easier than most radios because they are housed in a plastic case. A plastic case does not provide an adequate shield for serious RF components. In some of these cases, putting grounded foil around the radio, or changing the radio location and orientation, has changed the symptoms. But if you want quality performance, select a solid radio.

Power supply. Power supplies have been known to cause problems for HF users because they change voltage when the load on them changes. If the transmitter is drawing heavy current, as transmitters do when they are running at peak input power, the voltage to the antenna coupler may change enough to cause the coupler to either drop into a reset mode (under +11 VDC being present) or, the transmitter final amplifier impedance may change greatly, thus changing the tuning solution.

To alleviate this condition, remember to use a power supply that has both adequate current handling capacity and good dynamic regulation. Better yet, use a regulated power supply of an adequate rating.

11.4 A Final Pointer on Troubleshooting

Remember that the SMARTUNER is an excellent piece of equipment that will give outstanding performance. If you have a problem with the coupler finding a tuning solution, you should *change one variable at a time.*

12.0 Further Reading

Further information regarding applications, installation and operation can be downloaded from www.sgcworld.com. These publications include:

- HF User's Guide
- Go Mobile at 500 Watts
- Stealth Antennas
- Smartuner Antenna Coupler Manuals

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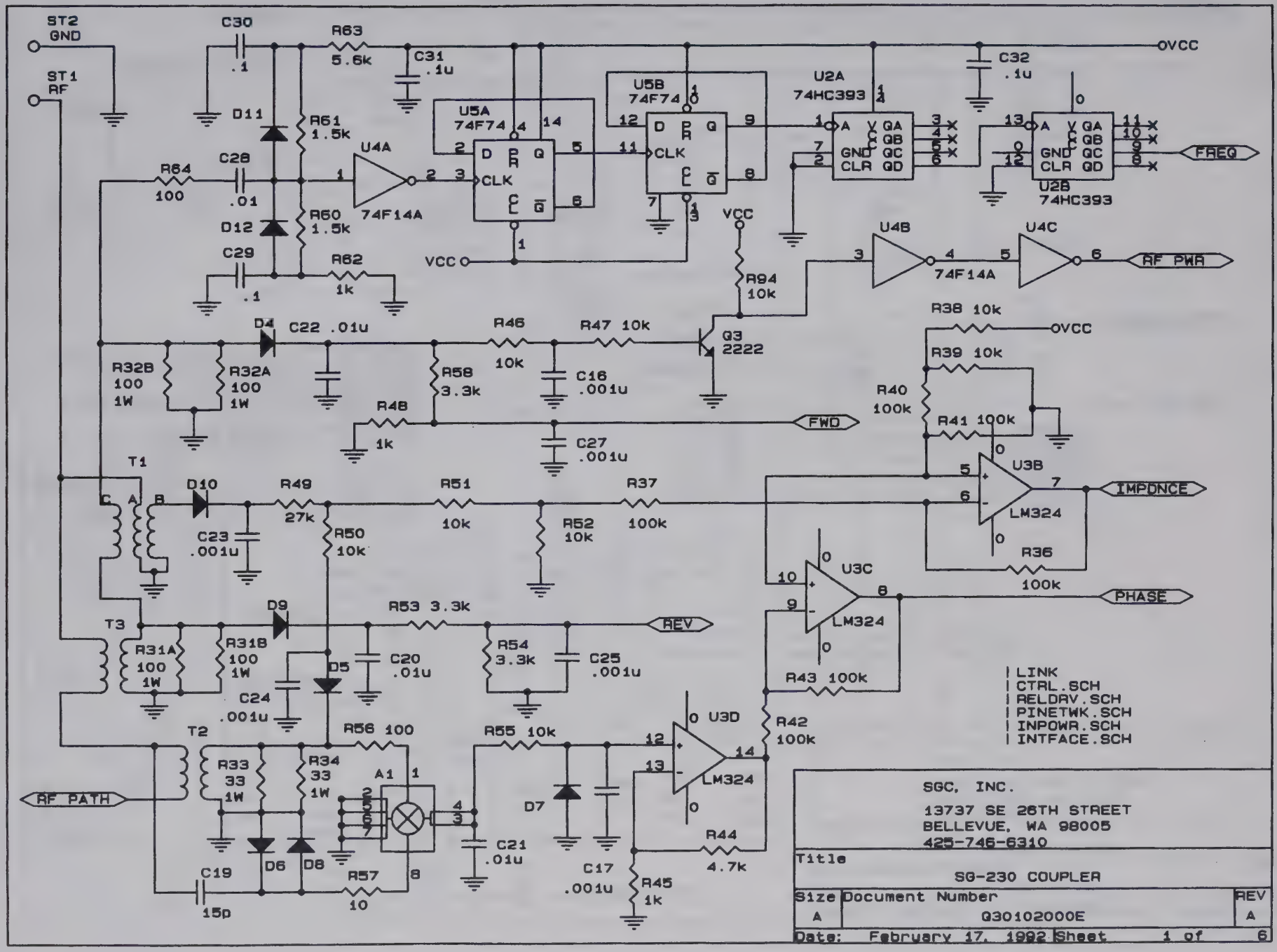
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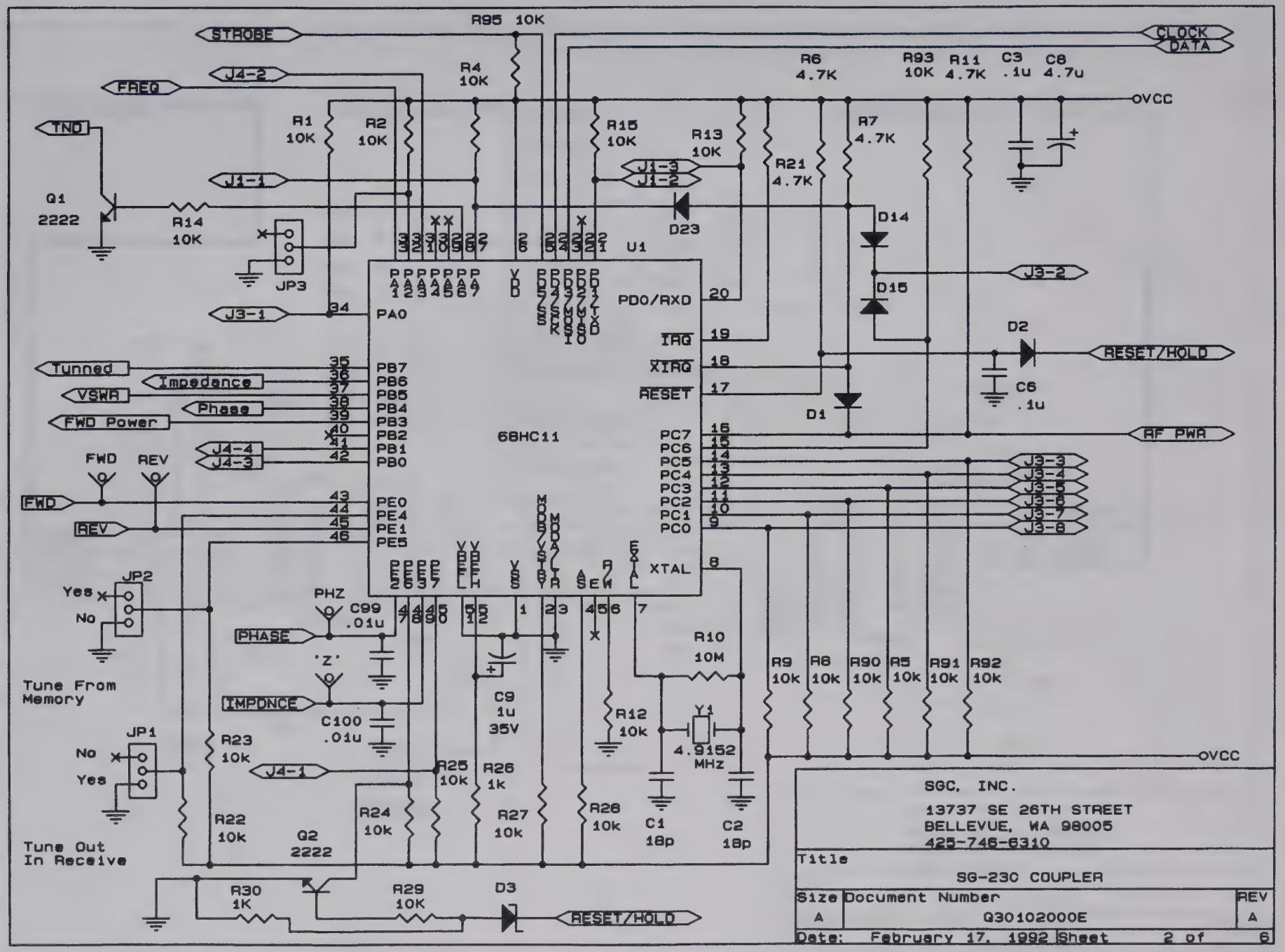
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PB5
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PB1
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R92
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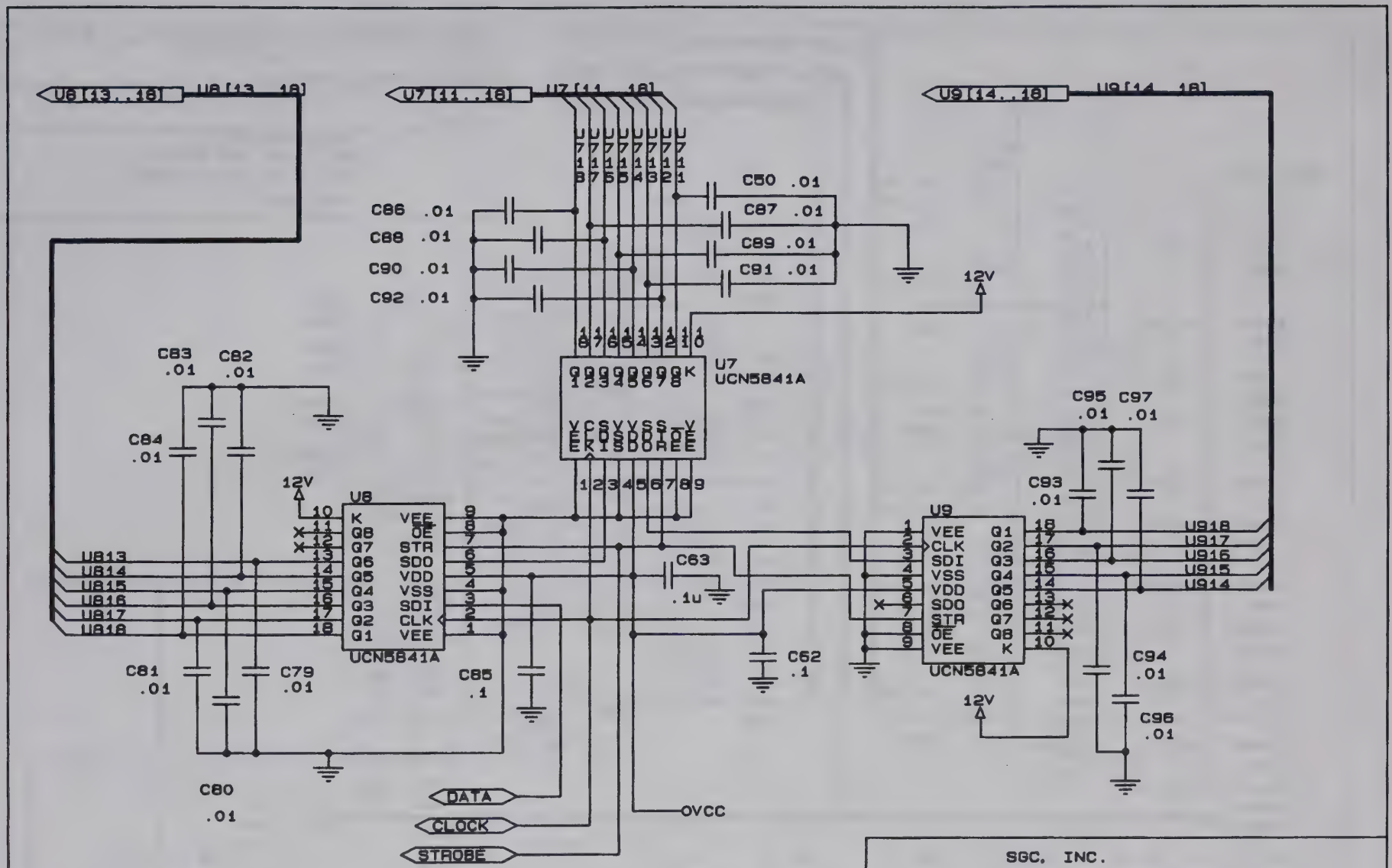

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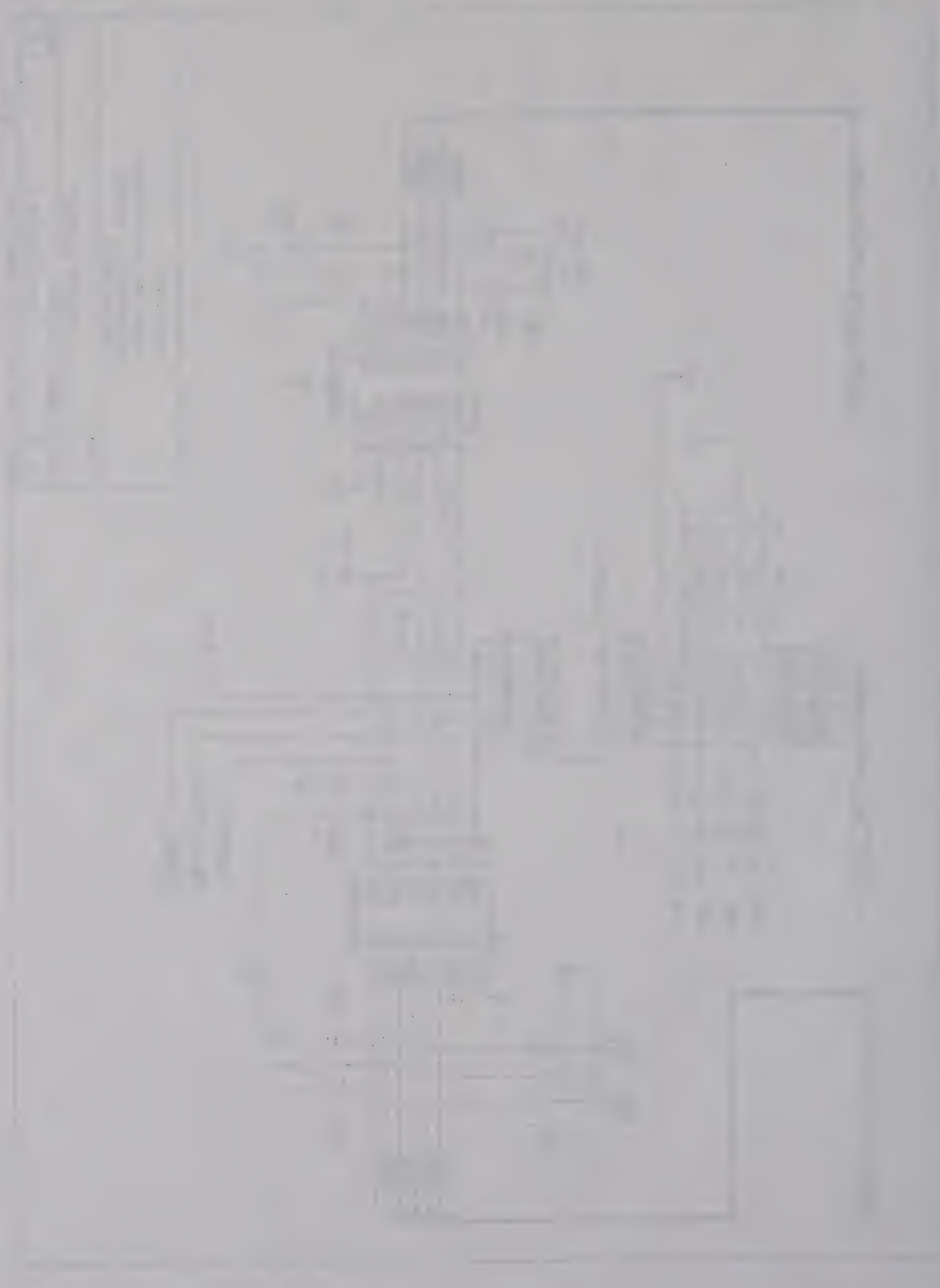

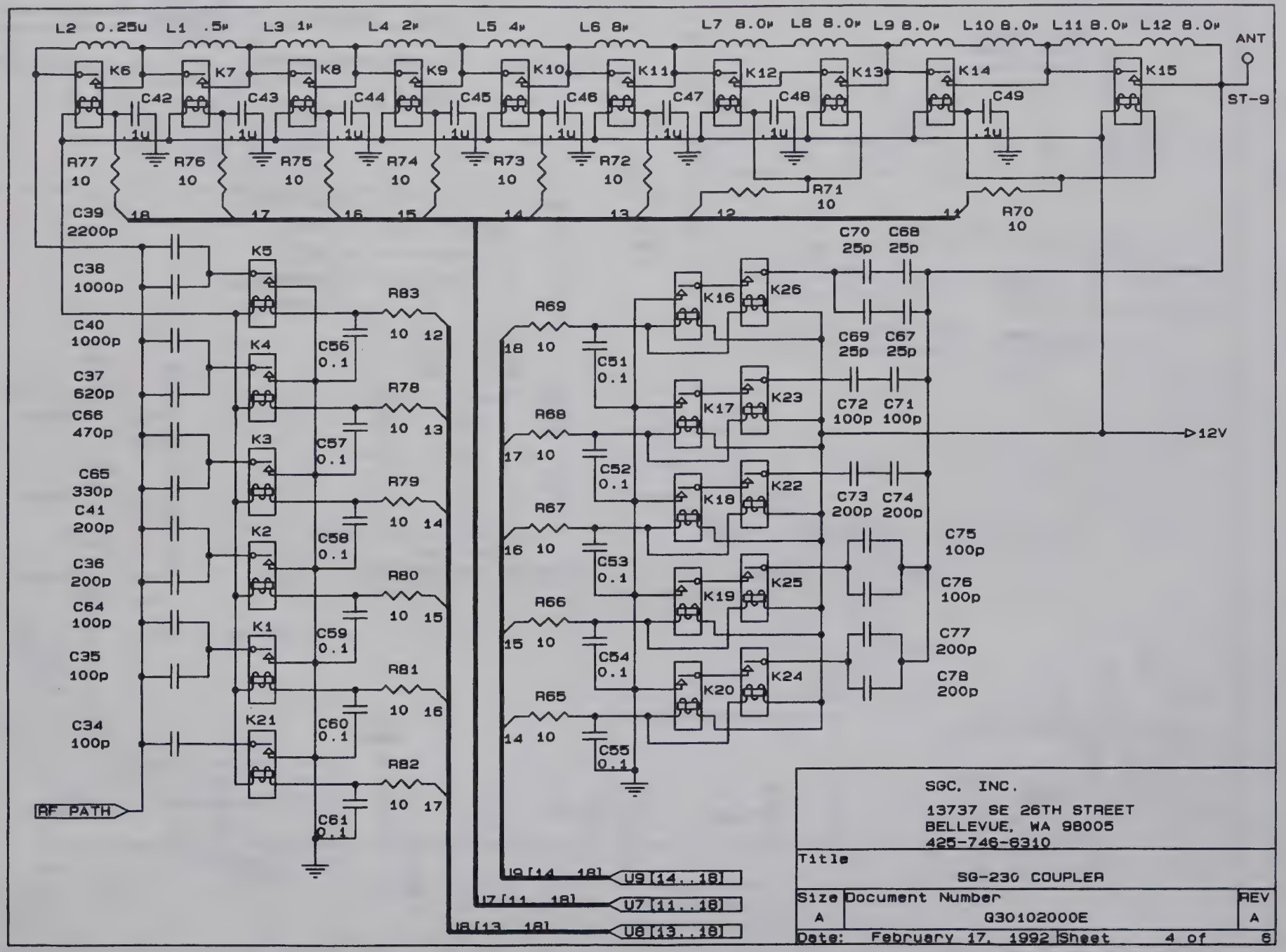
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ANT
ST-9
K6 K7 K8 K9 K10 K11 K12 K13 K14 K15
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.1u
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R76 10
R75 10
R74 10
R73 10
R72 10
R71 10
R70 10
C39 2200p
18 17 16 15 14 13 12 11
C38 1000p
C40 1000p
C37 620p
C66 470p
C65 330p
C41 200p
C36 200p
C64 100p
C35 100p
C34 100p
K5 K4 K3 K2 K1 K21
C56 C57 C58 C59 C60 C61
0.1
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10 13
10 14
10 15
10 16
10 17
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C69 C67 25p 25p
C72 C71 100p 100p
C73 C74 200p 200p
C75 100p
C76 100p
C77 200p
C78 200p
12V
K16 K17 K18 K19 K20 K26 K23 K22 K25 K24
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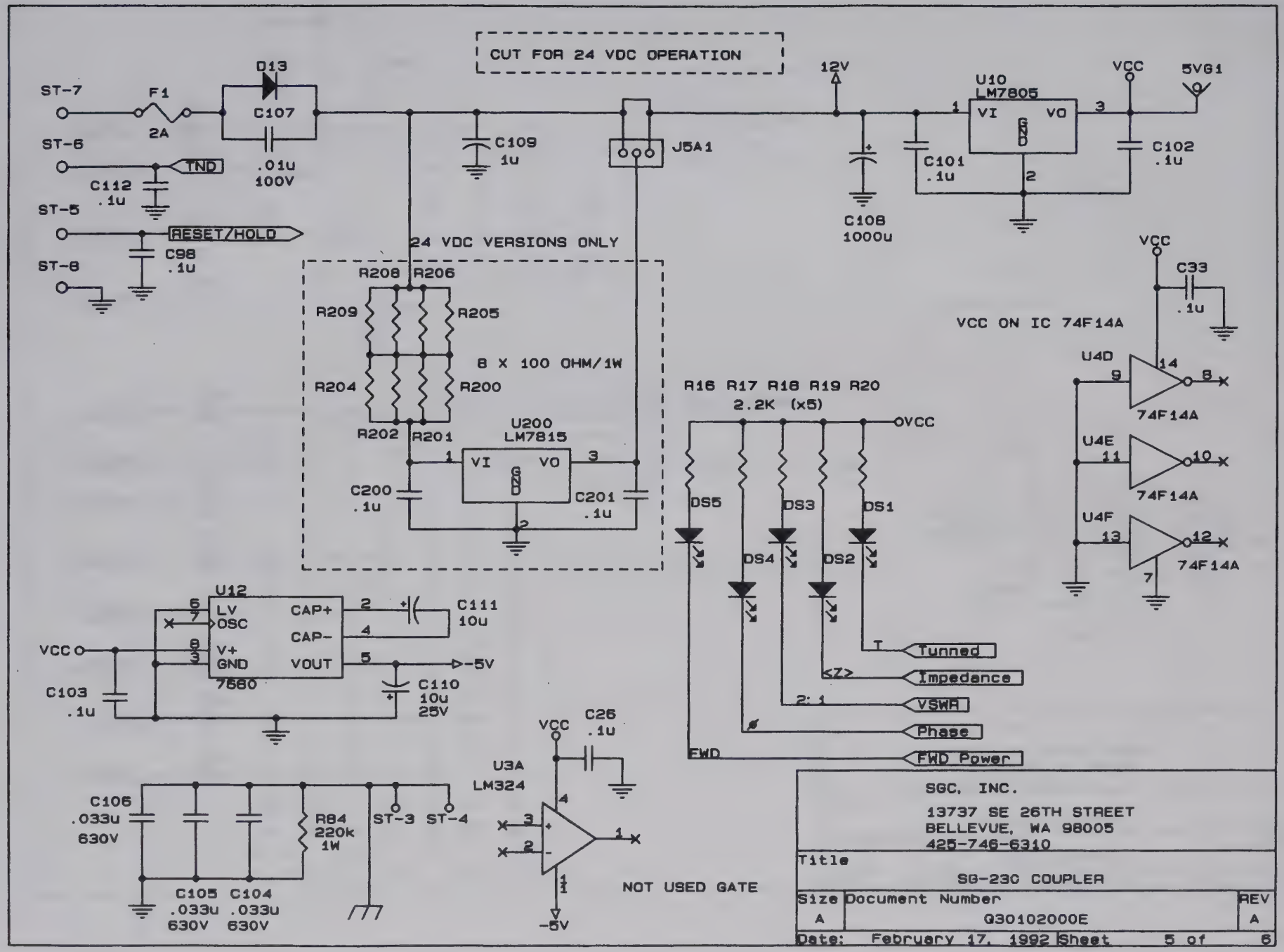
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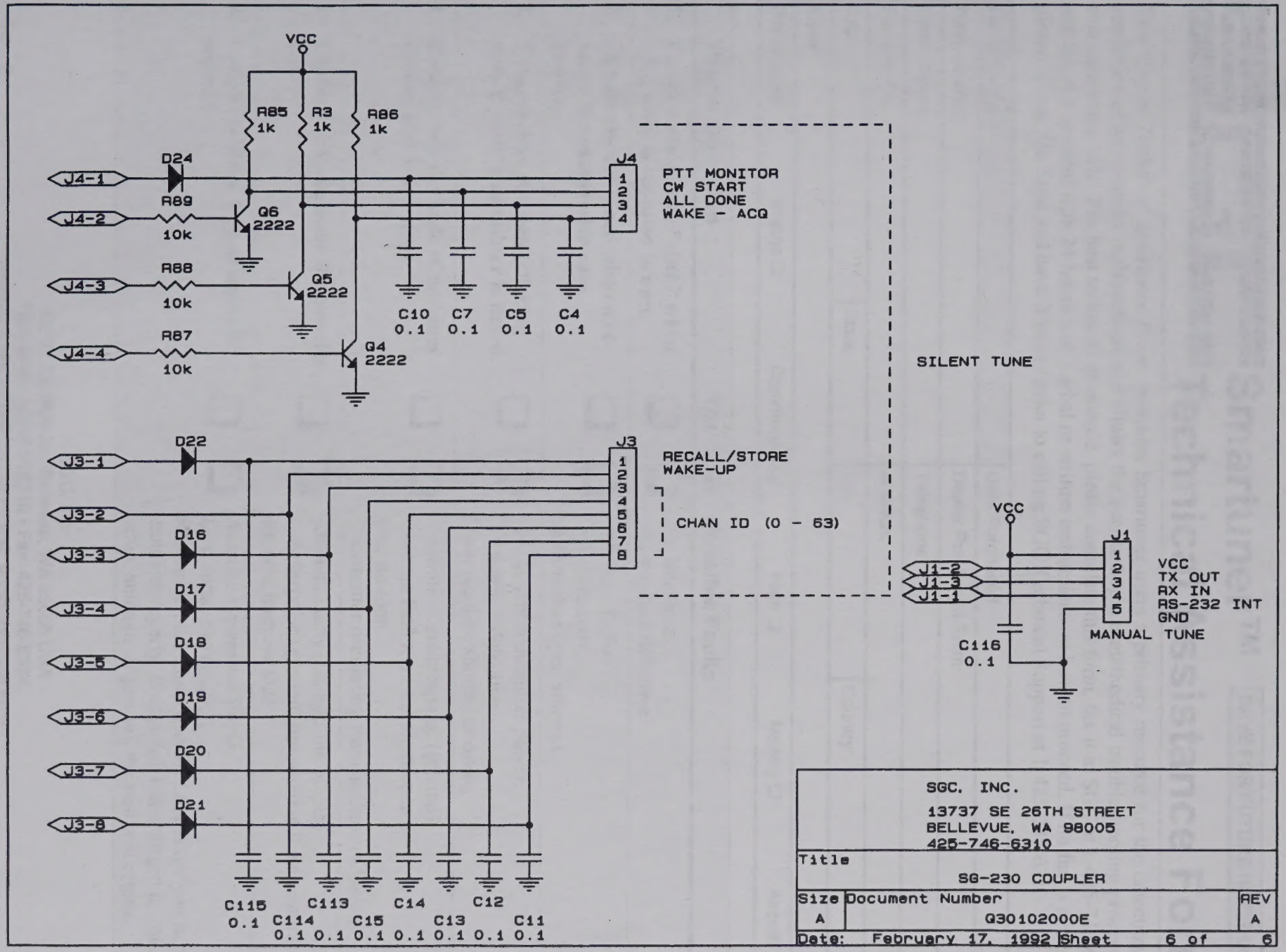
RESET/HOLD
C98
.1u
ST-8
C109
1u
J5A1
12V
C108
1000u
U10
LM7805
VI
GND
VO
C101
.1u
VCC
C102
.1u
5V61
24 VDC VERSIONS ONLY
R208
R206
R209
R205
R204
R200
R202
R201
8 X 100 OHM/1W
U200
LM7815
C200
.1u
C201
.1u
VCC
C33
.1u
VCC ON IC 74F14A
U4D
U4E
U4F
74F14A
R16 R17 R18 R19 R20
2.2K (x5)
VCC
DS5
DS3
DS1
DS4
DS2
T
Tunned
<Z>
Impedence
2:1
VSWR
Phase
FWD
FWD Power
U12
LV
OSC
V+
GND
CAP+
CAP-
VOUT
7660
C111
10u
-5V
C110
10u
25V
C103
.1u
C26
.1u
U3A
LM324
NOT USED GATE
C106
.033u
630V
C105
.033u
630V
C104
.033u
630V
R84
220k
1W
ST-3
ST-4
SGC, INC.
13737 SE 26TH STREET
BELLEVUE, WA 98005
425-746-6310
Title
SG-230 COUPLER
Size
A
Document Number
Q30102000E
REV
A
Date: February 17, 1992
Sheet 5 of 6



SGC, INC. 13737 SE 26TH STREET BELLEVUE, WA 98005 425-746-6310		
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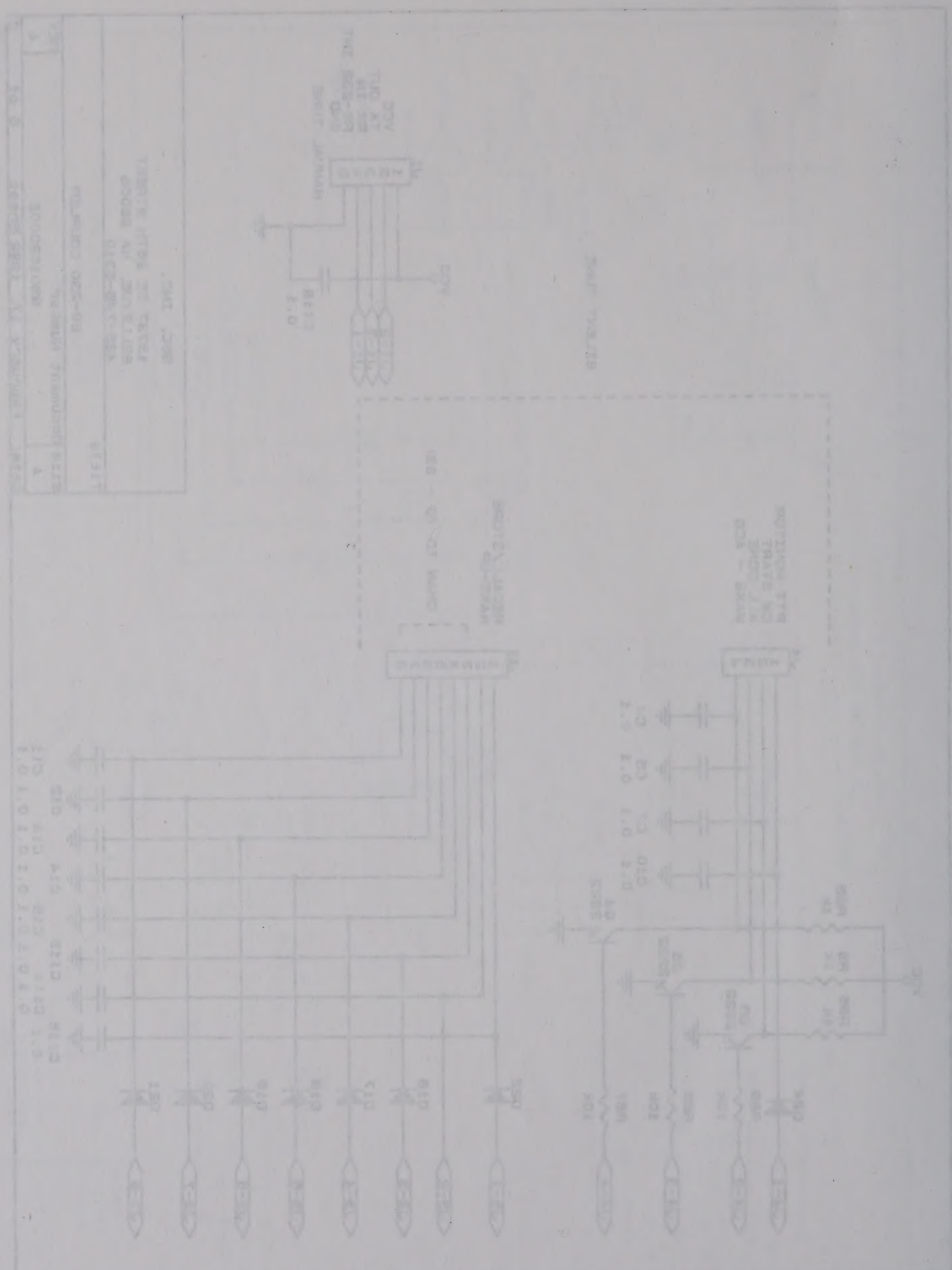

Smartuner™ Technical Assistance Form

SAVE FOR FUTURE REFERENCE

This *Urgent Technical Assistance Form* provides Smartuner users a primary resource for the detection and resolution of any coupler malfunctions and allows the user to begin a methodical troubleshooting process before contacting SGC. For best technical assistance, please complete this form, fax it to SGC at 1-425-746-6384 and we will respond with 24 hours with verbal or written instructions on how to proceed. If no fax is available, please fill out this form and have it handy prior to calling SGC Technical Support at 1-425-746-6310.

Serial Number:		Date Purchased:	
Date Installed:		Dealer Purchased From:	
Owner Name:		Telephone:	
Fax Number:		Address:	
City:	State:	Zip:	Country:
Email:			
Primary Use:	Marine ❑ Commercial ❑ Ham ❑ Military ❑ Aircraft ❑		

	Proper Operation	Yes	No	Possible Faults
1.	**Coupler makes one "click" when 12v power is supplied to unit.**	❑	❑	12v line open. Internal fuse defective.
2.	**Signals are not heard when a receiver in connected to coax feedline.**	❑	❑	Defective radio. Defective coax. Defective or open antenna.
3.	**Coupler does not seek (clicking noises) when transmitter is keyed.**	❑	❑	Insufficient transmitter power. Transmitter defective. Coax feedline shorted or open.
4.	**Coupler will not lock. (Continues cycling and won't stop)**	❑	❑	Insufficient counterpoise (ground). Antenna faulty, partial short/open. Ground loop. Transmitter oscillating from antenna radiation.
5.	**Coupler locks on some frequencies only.**	❑	❑	Antenna faulty (change ant. length). Counterpoise (ground) too small at the operating frequency. Increase size.
6.	**Coupler will not memorize/recall settings.**	❑	❑	Antenna system not stable. Low voltage to coupler. Remember, the Smartuner will not allow you to operate improperly. If anything has changed in your setup, antenna, or ground, the unit will retune.

SGC, Inc.
13737 SE 26th St., Bellevue, WA 98005 USA
Telephone: 425-746-6310 • Fax: 425-746-6384
Internet: www.sgcworld.com • Email: sgc@sgcworld.com

© April 2002

Smartuner™ Technical Assistance Form

SAVE FOR FUTURE REFERENCE

Proper Operation	Yes	No	Possible Faults
7. Coupler locks on CW then retunes when used in voice mode on same frequency.	❑	❑	Check DC supply voltage under load. Voltage must remain above 11v. Loose ground/antenna connections. Defective transmitter - oscillating.
8. Unsure of coupler operation.	❑	❑	Place ≥ 100W light bulb between coupler output and ground. Apply 100W CW. Note if bulb lights.
9. Still unsure of coupler operation.	❑	❑	Same test as 8, but use four 100W light bulbs in series (110v or 220v type)
10. Coupler will not work in car.	❑	❑	Ground fault or ground loop. Add, repair and bond as required.
11. Poor mobile signal reports on 3.8 MHz.	❑	❑	Using unloaded antenna. Use SG-303 dual element antenna. Use of QMS is highly recommended.
12. Coupler will no tune 1.9 MHz.	❑	❑	Insufficient ground. Antenna too short. Refer to coupler manual for minimum antenna length requirement.
13. Radio will not develop full power output even though coupler is tuned.	❑	❑	Radio VSWR protection too sensitive (generally on inexpensive radios). Use commercial grade radio - see SGC's product line.
14. When using QMS installation, radio will not tune on all frequencies.	❑	❑	Ground fault. Change antenna feedwire length or remove extra wire in QMS housing.
15. On 1.8 MHz, coupler will not stay locked.	❑	❑	Use SGC's SmartLock. Retuning when near large trucks is normal on 1.8 MHz if SmartLock is not used and vehicle is in motion.

NOTE: As you troubleshoot your installation, remember there are three variables and you should change each variable in sequence to determine which one might be causing difficulty. The variables to check are: Ground (counterpoise) system, antenna faults and transmitter faults. Your best troubleshooting tool is a 100 watt lightbulb for 110 or 220 VAC. On the output of the transmitter this bulb should light, and when connected to the coupler output it should light. The lightbulb will light with voice modulation and emit steady brilliance in CW mode. Use a continuity test to insure that any extension cable is not shorted or open. Refer to your Smartuner™ manual.

SGC, Inc.
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